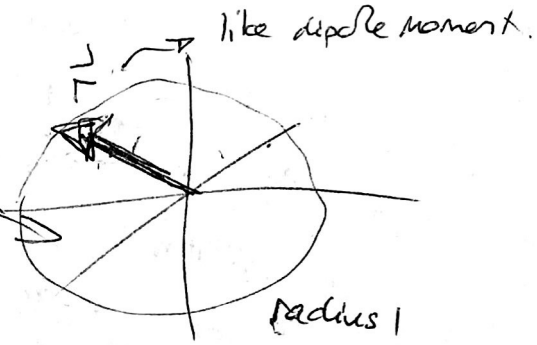
qubit general state:

$$\hat{\rho}_i = \frac{1}{2}\left(\hat{I} + r_x\hat{\sigma}_x + r_y\hat{\sigma}_y + r_z\hat{\sigma}_z\right) \qquad \underbrace{0 \le r_x^2 + r_y^2 + r_z^2}_{r^2} \le 1$$

can represent by vector $\vec{r} = r_x\hat{x} + r_y\hat{y} + r_z\hat{z}$

All possible states in sphere

Physical processes represented by vector.




e.g. evolution.

- phase shift about $\hat{z}$ through $\varphi$

$$\hat{U} = e^{-i\varphi\hat{\sigma}_z/2}$$

→ get $\hat{\rho}_f = \hat{U}\rho_i\hat{U}^\dagger$

↳ what vector $\vec{r}$ now represents

e.g. measurement:

- want measure in $|0\rangle, |1\rangle$ basis

prob(0) = ? } for $\hat{\rho}_i$
prob(1) = ? } for $\hat{\rho}_f$

- what about $\langle\sigma_z\rangle$ = prob(0) − prob(1)

or $\langle\sigma_x\rangle$ = ??